The aggregate effects of advance notice requirements

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Introduction and summary

It is well known that the performance of labor markets, measured in terms of unemployment rates or employment to population ratios, is much stronger in the U.S. than in many European countries. In order to improve the performance of European labor markets then, it is important to determine the cause of these differences. While the degree of unionization, the unemployment insurance system, or minimum wage legislation can have significant effects, most of the literature has focused on firing restrictions as the main candidate. Firing restrictions stand out because they are relatively minor in the U.S., compared with many countries with poor labor market performance.

Firing restrictions take several forms in these countries. The most common forms are severance payments, advance notice requirements, and procedural constraints. Severance payments are mandated payments that the employer must give to the worker at the time of employment termination. They vary as a function of the years of service and the perceived fairness of the dismissal. Advance notice requirements impose a pre-notification period that delays the time of employment termination. In turn, the procedural constraints require employers to seek authorization from an outside party prior to performing a dismissal (the outside party being a union, a work council, the government, or the courts). Usually, the authorization procedure is long and costly, and the employer is forced to provide full pay to the worker while the procedure is underway.[1]

The theoretical literature has typically modeled these forms of firing restrictions in a very simple way: as firing costs that involve either a fixed loss of resources or a fixed payment to the government per unit reduction in employment (firing taxes). While this may be a good first approximation, not many attempts have subsequently been made to model more explicitly the different forms of firing restrictions. The purpose of this article is to analyze the effects on aggregate output, wages, employment, and welfare levels of one particular form of firing restriction, namely, advance notice requirements. I also provide a comparison with the effects of firing taxes to assess the differences between both types of policies.

The empirical literature provides good reasons to analyze advance notice requirements separately from other forms of firing restrictions: It suggests that they may have different effects. In a very influential paper, Lazear (1990) constructed two measures of job protection for a set of 22 countries: the amount of severance payments that employers are required by law to pay to blue-collar workers with ten years of experience at the time of termination; and the period of advance notice that employers are required to give to this same class of workers. Lazear then compared these measures with measures of labor market performance, such as employment to population ratios and unemployment rates. Table 1 (overleaf) reproduces the average employment–population ratios, severance payments, and advance notice requirements between 1956 and 1984 for the 22 countries. Figure 1 plots the average employment–population ratios and severance payments, showing a negative relation between the two variables. However, this analysis does not take into account the large variations in labor market institutions over time within each of these countries: Generally, job security provisions were introduced in the 1960s, reinforced in the 1970s, and somewhat loosened in the 1980s. To account for this time variation, Lazear performed a *panel data analysis*, using yearly observations for each country to regress severance payments against employment–population ratios. His results indicate

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TABLE 1

Data for sample countries, 1956–84

	Employment /population	Severance pay	Advance notice
		(months of wages)	*(months)*
Austria	0.43	0.93	3.00
Australia	0.41	0.00	0.00
Belgium	0.38	1.24	1.00
Canada	0.38	n.a.	n.a.
Denmark	0.46	0.48	6.00
Finland	0.47	n.a.	n.a.
France	0.40	5.24	1.86
Germany	0.43	1.00	1.86
Greece	0.37	1.00	10.00
Ireland	0.35	0.00	0.00
Israel	0.33	8.41	n.a.
Italy	0.37	15.86	n.a.
Japan	0.48	0.00	n.a.
Netherlands	0.35	n.a.	2.00
Norway	0.42	12.00	3.00
New Zealand	0.38	0.00	n.a.
Portugal	0.37	3.36	2.59
Spain	0.35	13.56	n.a.
Switzerland	0.49	0.00	1.00
Sweden	0.48	0.00	0.76
United Kingdom	0.44	n.a.	0.90
United States	0.39	0.00	0.00

Note: n.a. indicates not available.
Source: Lazear (1990).

that introducing severance payments of three months of wages is typically accompanied by a decrease in the employment–population ratio of about 1 percent.

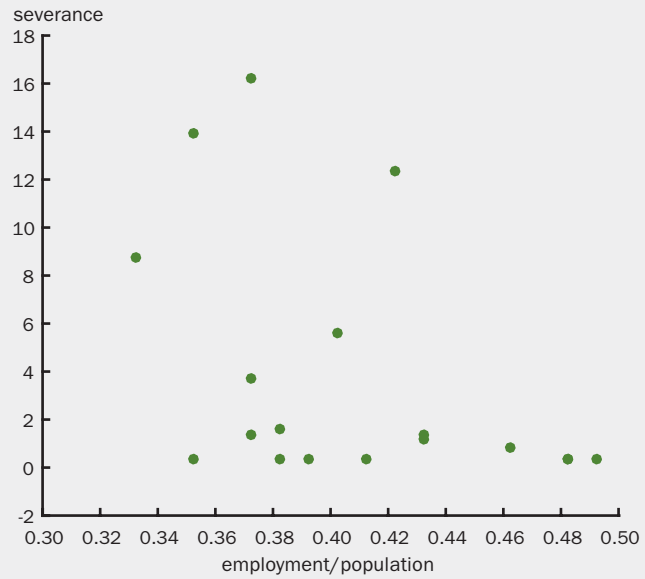
Figure 2 plots average employment–population ratios and average advance notice requirements. The plot shows a negative relation, but one that is much weaker than that in the previous figure. However, when the time variation within countries is taken into account, Lazear found that advance notice requirements reduce employment even more than severance payments. He considered this result to be surprising: "At worst, the employer could treat notice requirements as severance pay, simply by telling the worker not to report during the notice period and paying him anyway" (Lazear, 1990, p. 712).

In a later paper, Addison and Grosso (1995) provided revised estimates for the effects of severance payments and advance notice requirements. Including some additional countries and correcting some data errors from Lazear's study, Addison and Grosso found similar effects for severance payments but opposite results for advance notice requirements. Indeed, they found that longer notice intervals are associated with statistically significant *increases* in employment and labor force participation rates.

In the theoretical literature, an early study of the effects of firing costs was provided by Bentolila and Bertola (1990). Taking factor prices as being exogenous to their analysis (that is, using a *partial equilibrium* setting), Bentolila and Bertola studied the consequences of imposing firing costs on a monopolist facing a shifting demand for its product. In that context, firing costs potentially have two opposing effects. On one hand, firing costs induce the monopolist to avoid large contractions in employment after reductions in demand in the hope that demand will increase in the near future. On the other hand, they make the monopolist less willing to hire workers after increases in demand because of the prospective firing costs that will have to be paid when demand shifts down in the future. Under a *parameterization* that reproduces observations from European countries, Bentolila and Bertola found that the first effect is the most

FIGURE 1

Severance payments



Source: Lazear (1990).

important: Firing costs actually increase the average employment level of the monopolist.

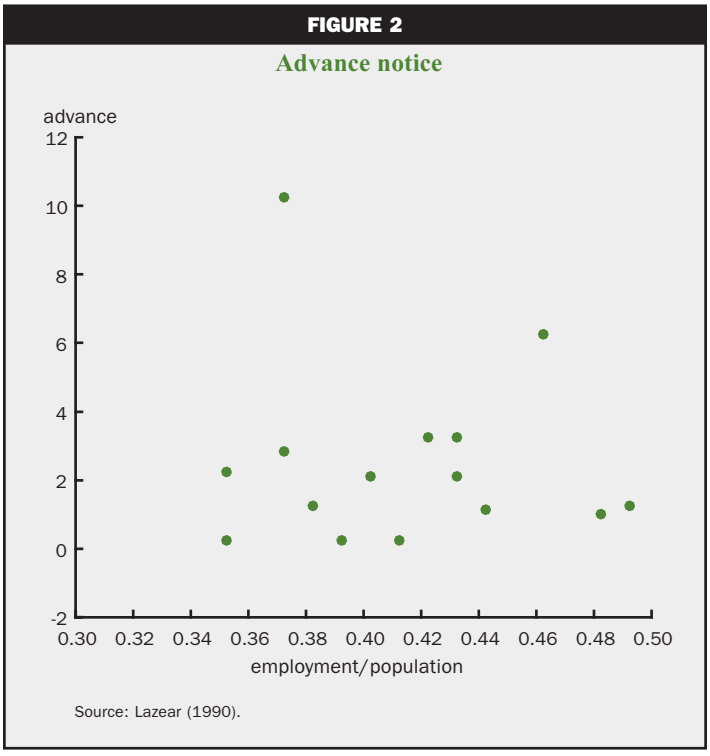
Hopenhayn and Rogerson (1993) performed a richer analysis, which allowed factor prices to clear markets instead of treating them as exogenous (that is, they performed a *general equilibrium* analysis). In their model economy, production is carried out by a large number of establishments that are subject to changes in their individual productivity levels, which induce them to expand and contract employment over time. Households supply labor, own the establishments, and have access to perfect insurance markets. In that framework, Hopenhayn and Rogerson introduced firing taxes that were rebated to households as lump sum transfers. In this model, firing taxes give rise to an important misallocation of resources. The reason is that establishments that switch to a low individual productivity level do not contract their employment as much as they should in order to avoid current firing taxes. On the other hand, establishments that experience high individual productivity levels do not expand their employment enough, because they try to avoid paying firing taxes in the future. This misallocation of resources across establishments reduces labor productivity quite substantially. The decrease in labor productivity induces a large substitution from market activities toward leisure and leads to a reduction in total employment. This effect can be quite significant: Firing taxes equal to one year of wages reduce employment by 2.5 percent. Hopenhayn and Rogerson (1993) also calculated the welfare costs associated with the firing taxes. They found that a permanent increase in consumption of 2.8 percent is needed to leave agents in the equilibrium with firing taxes indifferent with moving to the equilibrium without firing taxes.

The model I use in this article is similar to that analyzed by Hopenhayn and Rogerson (1993). The main difference is that I use it to evaluate not only the effects of firing taxes in general, but also the particular effects of advance notice requirements. The model introduces advance notice requirements in a very parsimonious way. If an establishment decides not to give advance notice to any of its workers, the following period it can expand its employment but not reduce it. On the other hand, if an establishment gives advance notice to some of its workers, it cannot rehire them during the following period.[2] Clearly, advance notice requirements have a firing penalty component, since employers must pay wages during the notice period, despite not needing the workers. But advance notice requirements have an additional effect: They hold workers to their jobs during the period of notice. This is an important effect. I find that, contrary to firing taxes, advance notice requirements do not have a negative effect on aggregate employment. However, the welfare costs of advance notice requirements can be substantially larger.

To gain a better understanding of these results, I start with a partial equilibrium version of the model, in which prices are fixed. Comparing the effects of advance notice requirements in this setting with those corresponding to the general equilibrium framework allows me to isolate the importance of equilibrium price changes to the results. I also analyze the effects of advance notice requirements assuming that once a worker is given advance notice, his productivity on the job decreases quite substantially. This version of the model not only adds some realism, but also shows that shirking behavior is an important variable to consider when analyzing advance notice requirements.

The article is organized as follows. In the next section, I analyze the effects of advance notice in a partial equilibrium framework. Then, I study the effects in a general equilibrium model. Next, I incorporate the assumption that advance notice requirements generate shirking behavior by workers. Finally, I compare advance notice requirements with firing taxes.

FIGURE 2



Source: Lazear (1990).

Partial equilibrium

In this section, I analyze the effects of advance notice requirements assuming that prices are fixed. The purpose is to isolate the partial equilibrium effects of advance notice requirements from those that arise from general equilibrium effects (that is, from equilibrium price changes).

Consider the problem of a single producer facing a constant wage rate w and interest rate i. For simplicity, I assume that output depends only on labor input. In particular, the production function is given by:

$$y_t = s_t n_t^{\gamma},$$

where y_t is output, n_t is the labor input, γ is a parameter governing the productivity of labor, with $0 < \gamma < 1$, and s_t is a productivity shock (that is, a higher value of s_t means that more output can be produced with the same labor input). The shock s_t follows a *Markov process* with *transition matrix* Q. That is, $Q(s,s')$ is the probability that $s_{t+1} = s'$, conditional on $s_t = s$.

When no government regulations are introduced, the establishment chooses its labor input to equate the marginal productivity of labor to the wage rate, that is,[3]

$$1) \quad w = s_t \gamma n_t^{\gamma-1}.$$

However, I am interested in studying how the behavior of the establishment is affected by the introduction of advance notice requirements. In principle, the establishment could give firing notice to all its workers every period and rehire them at will in the following period, according to the value that the productivity shock takes. If this were possible, advance notice requirements would clearly have no effects. But, given that this alternative is not available to employers in the real world, I consider a notice requirement policy that precludes this possibility altogether. More precisely, my policy specifies that: a) if the establishment gives notice to any number of workers, it cannot rehire in the following period; and b) if the establishment does not give advance notice to any worker, it cannot fire the following period, but it can hire at will.

Under such a policy, the problem of the establishment is much more complicated because it becomes dynamic. At any given time, the establishment has to decide to how many (if any) of its workers it will give advance notice. To do this, the establishment must forecast the value that the productivity shock will take in the following period. The relevant state variables for making its employment decision are its current labor force n and its current productivity shock s. If the establishment gives advance notice to some of its workers, which forces its next period employment to a value n' below its current period employment, the establishment will not be able to rehire any workers in the following period under any of the realizations of the productivity shock s'. It is forced to employ n' workers across all realizations of the productivity shock. The other alternative is not to give advance notice to any of its workers. In this case the establishment cannot contract employment below n in the following period, but it is free to hire. Thus, next period employment can be made contingent on the realization of the productivity shock s', as long as it is larger than the current employment level n. A profit-maximizing establishment will choose the best of both alternatives. Box 1 describes the establishment's problem more formally.

I am interested in describing the aggregate behavior of a large number of establishments similar to the one described so far. For this purpose, I assume that there are a large number of establishments facing the same random process for the individual productivity shock, but that the realizations of the shock are independent across establishments.

I need to incorporate entry and exit of establishments, at least exogenously, because a substantial probability of exit will affect how establishments change their employment levels in response to their productivity shocks. For this purpose, I assume that the transition matrix Q for the individual productivity shocks is such that: 1) starting from any initial value, s_t reaches zero in finite time with probability one; and 2) once s_t reaches zero, there is zero probability that s_t will receive a positive value in the future. Given these assumptions, a zero value for the productivity shock can be identified with the death of an establishment. While establishments exit, v new establishments are exogenously created every period. The distribution of new establishments across productivity shocks is given by ψ. The new establishments can hire workers freely during their first period of activity since they are created with zero previous period employment.

The state of the economy is described by a distribution x_t, defined over idiosyncratic productivity shocks s and employment levels n. Equation 4 in box 2 describes the law of motion for x_t in formal terms. Intuitively, the next period's number of establishments with a productivity shock s' and employment level n' is given by the sum of two terms. A first term gives the number of establishments that transit from their current shock s to the shock s' and choose an employment level n'. A second term includes all new establishments born with a shock s', in case the unrestricted employment level that corresponds to the shock s' is given by n'. In this article, I concentrate on steady state equilibria, where the distribution x_t is invariant over time.

BOX 1

Establishment's problem

Assume that the maximum present value of profits that can be attained starting from the state (n,s) is given by $V(n,s)$. If the establishment gives advance notice to some of its workers, the best it can do is given by the following problem:

$$2) \quad F(n,s) = \max_{n' < n} \{sn^{\gamma} - wn + \frac{1}{1+i} \sum_{s'} V(n',s')Q(s,s')\}.$$

If the establishment does not give advance notice to any of its workers, the best it can do is given by:

$$3) \quad H(n,s) = \max_{n'(s') \geq n} \{sn^{\gamma} - wn + \frac{1}{1+i} \sum_{s'} V(n'(s'),s')Q(s,s')\}.$$

If $V(n,s)$ indeed describes the present value of profits under the optimal employment plan, it must be equal to the maximum of the two alternatives given by equations 2 and 3. Thus, the value function V satisfies the following functional equation:

$$V(n,s) = \max\{F(n,s), H(n,s)\}.$$

In computations, I restrict s to take a finite number of possible values. The value function V is obtained by iterating on this functional equation starting from some initial guess.

Given the invariant distribution x across establishment types, aggregate production c and aggregate employment η are given by summing production and employment across all establishments described by the distribution x. Formally, aggregate production and employment are given by equations 5 and 6 in box 2, respectively.

My purpose here is to obtain quantitative estimates of the effects of advance notice requirements. For these estimates to be meaningful, the parameters of the model must reproduce important empirical observations (a procedure known as *calibration*). Although the article is concerned with European labor market institutions, I choose to replicate observations for the U.S. economy because this a common benchmark in applied studies. Since there are neither advance notice requirements nor firing taxes in the U.S. economy, I use a laissez-faire version of the model to reproduce U.S. observations. These observations are from the National Income and Product Accounts and establishments' dynamics data reported by Davis and Haltiwanger (1990). The calibration procedure, which is similar to the one provided in Veracierto (2001), is described in box 3.[4]

Next, I describe the effects of introducing advance notice requirements of three months duration (the length of the model period) to the partial equilibrium model calibrated above. Since I have chosen parameters to reproduce U.S. observations, the experiments provide estimates of the effects of introducing advance notice requirements in the U.S. economy. Table 2 (on page 25) reports the results. The first column reports statistics for the economy without interventions (which have been normalized at 100), and the second column reports statistics for the economy with advance notice requirements. The variables are aggregate production c, wages w, and aggregate employment η.

There are two opposite effects of advance notice requirements on employment. On one hand, when establishments receive bad shocks, they cannot instantly contract their employment levels because they must give advance notice first. This tends to increase employment. On the other hand, when establishments receive positive shocks, they are less willing to hire workers, because if the shock is reversed, during the advance notice period they will be stuck with workers they don't need. This tends to lower employment. Table 2 shows (last row, second column) that this last

BOX 2

Aggregation

The law of motion for the distribution x_t is described by:

$$4) \quad x_{t+1}(n',s') = \sum_{\{(n,s):g(n,s,s')=n'\}} Q(s,s')x_t(n,s) + v\psi(s')\chi(n',s'),$$

where $g(n,s,s')$ is the next period employment level chosen by an establishment with current employment n and shock s when the realized next period productivity is s'; and where $\chi(n', s')$ is an indicator function that is equal to one if $g(0, s', s') = n'$ (and zero otherwise).

Given the invariant distribution x that satisfies equation 4 for all time periods t, steady state aggregate production c is given by:

$$5) \quad c = \sum_{n,s} sn^{\gamma}x(n,s)$$

and steady state aggregate employment η in turn is given by:

$$6) \quad \eta = \sum_{(n,s)} nx(n,s).$$

BOX 3

Calibration

I choose the interest rate to reproduce an annual rate of 4 percent, which is a compromise between the return on equity and the return on short-term debt (see Mehra and Prescott, 1985). This is also the value commonly used in the real business cycle literature. Since the model period is one quarter, i is selected to be 0.01.

When no government regulations are imposed, equation 1 shows that the curvature parameter γ in the production function determines the share of output that is paid to labor. As a consequence, it is selected to be 0.64, which is the share of labor in the national income accounts. I choose the wage rate w, in turn, to reproduce an average establishment size equal to 60 workers, which is consistent with *Census of Manufacturers* data. On the other hand, I select the number of establishments created every period ν to generate a total employment level equal to 80 percent of the population, roughly the fraction of the working age population that is employed in the U.S. economy.

I restrict the stochastic process for the productivity shocks to be a finite approximation to the following process. Realizations of the shock take values in the set:

$$\Omega = \{0\} \cup [1, \infty)$$

and the transition function Q is assumed to be of the following form:

$$Q(0,\{0\}) = 1$$

$$Q(s,[1,\tilde{s}]) = \frac{1}{\mu}\Pr\{(a + \rho \ln s + \varepsilon') \in [1,\tilde{s}]\}, \text{ for } s,\tilde{s} \geq 1,$$

where a, ρ, and μ are constants and ε' is an i.i.d. (independently and identically distributed) normally distributed shock with mean zero and standard deviation σ.

With this functional form for the transition function, there are four parameters to be determined: μ, a, ρ, and σ. In addition, I must choose the distribution ψ across idiosyncratic shocks. Since all these parameters are important determinants of establishment dynamics in the model, they are selected to reproduce observations about establishment dynamics. The observations used to calibrate these parameters are the employment size distribution reported by the *Census of Manufacturers*, the job creation and destruction rates reported by Davis and Haltiwanger (1990), and the five-year exit rate of manufacturing establishments reported by Dunne, Roberts, and Samuelson (1989).[1] The size distribution and the job creation and destruction statistics for the U.S. economy are displayed in table B1. The parameter values used to match these observations are reported in the appendix.

[1]Since the computations require a finite number of shocks and only nine employment ranges are reported in *Census of Manufacturers* data, nine values for the idiosyncratic shocks are used in the article.

Table B1
Statistics for U.S. and model economy

A. U.S. economy

Average size = 60%
Job creation due to births = 0.62%
Job creation due to continuing establishments = 4.77%
Exit rate = 36.2%
Job destruction due to deaths = 0.83%
Job destruction due to continuing establishments = 4.89%

Employment	Shares (%)	Employment	Shares (%)
5–9	23.15	250–499	3.86
10–19	22.82	500–999	1.68
20–49	24.83	1,000–2,499	0.73
50–99	12.59	>2,500	0.28
100–249	10.05		

B. Model economy

Average size = 59.6%
Job creation due to births = 0.72%
Job creation due to continuing establishments = 4.80%
Exit rate = 38.5%
Job destruction due to deaths = 0.72%
Job destruction due to continuing establishments = 4.80%

Employment	Shares (%)	Employment	Shares (%)
5-9	26.19	250–499	2.25
10–19	31.67	500–999	2.13
20–49	20.21	1,000–2,499	0.59
50–99	13.01	>2,500	0.02
100–249	3.92		

Source: Lazear (1990).

TABLE 2

Partial equilibrium analysis

	Laissez faire	Advance notice	Advance notice (shirk)	Firing taxes
Production	100.00	97.71	92.59	92.62
Wages	100.00	100.00	100.00	100.00
Employment	100.00	97.75	92.97	89.41

effect is the strongest: Introducing advance notice requirements reduces employment by 2.25 percent. We also see that even though employment decreases, this is not accompanied by an increase in labor productivity. In fact, we see that output decreases by roughly the same factor as employment. The reason is that with the introduction of the advance notice requirements, establishments that receive bad shocks do not contract employment (during the first period of the shock), and establishments that receive positive shocks do not expand employment enough. Thus, labor is allocated less efficiently across establishments.

General equilibrium

In the partial equilibrium analysis of the previous section, advance notice requirements reduce aggregate employment quite significantly (the effects have the same sign as in Lazear, 1990, and the opposite sign to the results in Addison and Grosso, 1995). However, there is an important reason to suspect that those partial equilibrium results are not reliable: The effects are so large that prices should have been significantly affected. Therefore, instead of assuming a fixed wage rate and interest rate, invariable to policy changes, in this section I investigate the effects of advance notice requirements allowing prices to adjust to clear all markets. That is, I provide a general equilibrium analysis of advance notice requirements. My results here show that equilibrium price changes are crucial for understanding the effects of this type of policy.

To formulate a general equilibrium analysis, I introduce a few modifications to the environment. The same continuum of establishments analyzed in the previous section is still responsible for production of the consumption good, but now I explicitly introduce a household sector. In particular, the economy is now populated by a continuum of ex ante identical agents, of size normalized to one. The preferences of the representative agent are given by:

$$E\sum_{t=0}^{\infty}\beta^t[\ln c_t - \alpha\eta_t],$$

where c_t is consumption, η_t is the fraction of the population that works, α is a positive parameter governing the marginal utility of leisure, and β is a discount parameter with $0 < \beta < 1$.

I restrict the analysis to a *steady state* equilibrium, where the wage rate w and the interest rate i are constant over time. There are two important decisions that a household has to make—how much to consume today relative to tomorrow and how much time to spend working. Consider the consumption decision first. If the household sacrifices one unit of consumption at date t in order to buy a bond, it loses the marginal utility of consumption at date t. In return, the household obtains $1 + i$ units of the consumption good at date $t + 1$, each of which is valued according to the marginal utility of consumption at date $t + 1$ and discounted according to β (in terms of utility at date t). If the household makes an optimal choice, the marginal loss of this decision at date t must be equal to the marginal gain at date $t + 1$. Since consumption (and therefore, the marginal utility of consumption) is constant in a steady state equilibrium, it follows that the steady state interest rate $1 + i$ must be equal to the inverse of the discount factor β. Observe that this interest rate is not affected by the introduction of advance notice requirements. As long as the economy is in a steady state, with constant consumption, the gross interest rate must be given by $1/\beta$.

Consider now the decision of how much time to spend working versus how much to consume. If the household spends one additional unit of time working, it loses the marginal utility of leisure. In return it obtains wage payments that allow it to buy w units of the consumption good, each of which is valued according to the marginal utility of consumption. If the household maximizes utility, the marginal loss from this intratemporal decision must be equal to the marginal gain. Thus, the wage rate w must be equal to the marginal rate of substitution between consumption and leisure:

$$7) \quad \alpha c = w.$$

Observe that in equilibrium, consumption c is given by the aggregate production of establishments (equation 5 in box 2, page 23). Also, the fraction of the population that works, η, must be equal to the demand for labor by establishments (equation 6 in box 2).

In order to perform the policy experiment, I choose parameter values identical to those in the partial equilibrium section, except for α and β, which are new. These two parameters are selected to generate the same wage rate w and interest rate i as in the partial equilibrium section. The required values are $\alpha = 0.80$ and $\beta = 0.99$.

TABLE 3

General equilibrium analysis

	Laissez faire	Advance notice	Advance notice (shirk)	Firing taxes
Production	100.00	99.18	97.24	97.25
Wages	100.00	99.18	97.24	97.25
Employment	100.00	100.05	100.37	96.51
Welfare (%)	0.00	0.86	3.08	0.56

When I introduce advance notice requirements, the wage rate must change in order to restore the equality with the marginal rate of substitution of consumption for leisure. Recall that when the advance notice requirements are introduced, table 2 shows that production drops quite substantially at the initial wage rate. Since the amount of production undertaken by establishments increases monotonically with decreases in the wage rate (because they increase their demand for labor), for the equality in equation 7 to be restored, the wage rate must decrease. As a consequence, both consumption and employment fall by a smaller amount than in the partial equilibrium analysis.

The first two columns of table 3 show that the general equilibrium results in fact lead to a much smaller drop in aggregate consumption—only 0.82 percent compared with the 2.29 percent drop in the partial equilibrium framework. Given the linear relation in equation 7, we know that the wage rate must also decrease in the same proportion. What is interesting to observe in table 3 is that the fall in the wage rate is enough to leave the employment level roughly unchanged (it increases only by 0.05 percent) instead of generating the substantial decrease (of 2.25 percent) obtained in the partial equilibrium framework. Thus, the general equilibrium results lead to employment effects that are more consistent with Addison and Grosso (1995) than with Lazear (1990).

Since this is a neoclassical economy, the equilibrium without interventions is Pareto optimal,[5] and introducing advance notice requirements can only reduce welfare levels. In fact, advance notice requirements produce significant deadweight losses. Table 3 shows that agents in the steady state with advance notice require a 0.86 percent permanent increase in consumption in order to be indifferent with being at the laissez faire equilibrium.

Advance notice and shirking behavior

Although I do not model it explicitly here, it is reasonable to expect that once workers are notified that they will be fired in the following period, their performance on the job will decrease considerably. To capture this effect, I assume that the productivity of workers that are given advance notice is reduced to a fraction ϕ of that of workers that are not given advance notice. However, workers that are given advance notice are paid the same wage rate as those that are not given advance notice. (Box 4 explains the modified establishments' problem and feasibility condition in detail).

Given that there are no data available for the shirking parameter ϕ, I go to the extreme and assume that it is equal to zero. In other words, I assume that workers' productivity drops to zero when they are given advance notice. The third column of table 2 reports the results for the partial equilibrium framework. We see that the effects of advance notice requirements are much larger when shirking behavior is present than when it is not. The reason is clear. Since establishments that contract employment must pay wages to workers without obtaining any production from them, the advance notice requirements impose much larger penalties. As a consequence, they have a much larger effect on the demand for labor, which drops by 7.03 percent instead of 2.25 percent. The drop in consumption is also much larger, 7.41 percent instead of 2.29 percent. This is due not only to the larger drop in the labor input, but also to the fact that production is severely affected when workers are given advance notice.

When we incorporate the general equilibrium effects, we see (in the third column of table 3) that the wage rate drops by such an amount that employment actually increases by 0.37 percent when the advance notice requirements are introduced. Given this increase in employment, the drop in consumption is reduced to 2.76 percent (compared with 7.41 percent in the partial equilibrium framework). It is worth mentioning that shirking behavior produces the same sign as the empirical relation between advance notice requirements and employment levels reported by Addison and Grosso (1995); however, the magnitude of the employment response is much smaller. Also, note that the welfare costs of notice requirements are much larger when shirking behavior is allowed for—3.08 percent instead of 0.86 percent, representing an extremely large welfare cost.[6]

Advance notice requirements versus firing taxes

Hopenhayn and Rogerson (1993) and Veracierto (2001) analyzed the effects of firing taxes in a framework similar to this and found large negative effects on employment, consumption, and welfare. The parameterization in this article is similar to one of the cases

BOX 4

Shirking behavior

In order to allow for shirking behavior, I modify the value of giving advance notice in equation 2 as follows:

$$F(n,s) = \max_{n' < n} \{ s[n' + \phi(n - n')]^{\gamma} - wn + \tfrac{1}{1+i} \sum_{s'} V(n', s') Q(s, s') \}.$$

The only other condition that must be modified in the general equilibrium analysis of the previous section is the one for aggregate consumption, which is now given by:

$$c = \sum_{(n,s):\text{notice is not given}} s n^{\gamma} x(n,s) + \sum_{(n,s):\text{notice is given}} s[n' + \phi(n - n')]^{\gamma} x(n,s).$$

analyzed in Veracierto (2001).[7] But, for that case, Veracierto (2001) only reported the effects of firing taxes equal to one year of wages. To facilitate comparisons with the advance notice requirements analyzed in this article, I report the effects of firing taxes equal to one quarter of wages (same length as the advance notice requirements).

The firing tax I consider is a tax on employment reduction, which is rebated to households as lump-sum transfers. Box 5 describes the establishment's problem in detail. Essentially, the establishment has to pay a tax in the next period equal to one period of wages per unit reduction in employment, whenever next period employment $n'(s')$ is lower than the current period employment n.

The partial equilibrium effects of firing taxes are reported in the last column of table 2. We see that the effects on consumption are as large as under advance notice requirements when shirking behavior is allowed for (7.38 percent versus 7.41 percent), but the effects on employment are considerably larger (10.59 percent versus 7.03 percent). The consumption results are not surprising. If shirking behavior leads to zero productivity, under advance notice requirements firms end up facing similar firing restrictions as under firing taxes. In both cases, workers who are fired make no contribution to production, while the establishment must pay their wages anyway. Certainly there is a difference between the policies: Under advance notice requirements the firing decisions must be taken in advance, while under firing taxes they can be made after the shocks are realized. However, with the high persistence of the productivity shocks, this difference is unimportant and, thus, the drop in output is almost the same in both scenarios.

What is important is the difference in terms of employment outcomes. Under firing taxes, when establishments receive a bad productivity shock, workers are fired right away. Under advance notice, these same workers must be employed an additional period before they can be fired. Consequently, employment is larger under advance notice requirements (when shirking behavior is allowed) than when firing taxes are introduced.

When the general equilibrium effects are considered, the drop in wages is virtually the same under firing taxes and advance notice requirements (with shirking behavior). But this decrease in wages is not large enough for firing taxes to increase employment. We see that employment falls by 3.49 percent. On the contrary, employment increases by 0.37 percent under the advance notice requirements (with shirking behavior).

Observe that the welfare costs of firing taxes are much smaller than those of advance notice requirements (with shirking behavior): 0.56 percent instead of 3.08 percent. The reason is that consumption drops by the same amount in both cases, but employment decreases more under firing taxes, allowing for a larger amount of leisure.

We see, in table 3, that the welfare costs of firing taxes are even smaller than those of advance notice requirements when shirking behavior is not allowed for: 0.56 percent versus 0.86 percent. The reason is that when establishments receive a zero productivity shock, workers are hired an additional period to comply with the advance notice requirement. This leads to a higher employment level and a lower amount of leisure. It is interesting to note that if the advance notice requirements were waived from establishments

BOX 5

Firing taxes

Under firing taxes the Bellman equation of establishments becomes:

$$V(n,s) = \max_{n'(s')} \{ s n^{\gamma} - wn + \tfrac{1}{1+i} \sum_{s'} \{ V(n'(s'), s') - w \max[0, n - n'(s')] \} Q(s, s') \},$$

where $V(n,s)$ is the present value, excluding current firing taxes, of an establishment with current employment n and current shock s.

This equation, together with equations 4, 5, 6, and 7, defines an equilibrium with firing taxes rebated as lump sum taxes.

that exit the market, the amount of employment η in the "advance notice" column would be 99.40 instead of 100.05 and the welfare cost of the policy would be 0.44 percent, a lower cost than that of firing taxes.

Conclusion

This article analyzes the effects of advance notice requirements in a general equilibrium model of establishment-level dynamics of the type introduced by Hopenhayn and Rogerson (1993). I find that when advance notice requirements do not lead to shirking behavior, the effects of advance notice requirements are relatively small. Establishments do not tend to alter their employment levels considerably for the following reasons: a) next period's productivity is likely to be similar to current productivity (given the high persistence of the shocks); b) employment can be freely increased if a good shock occurs next period; c) employment can be decreased after one period if a bad shock occurs; and d) during the period of notice the workers remain productive. In a partial equilibrium framework, I find that advance notice requirements reduce employment, but when I consider general equilibrium effects, employment is not much affected. The reason is that the advance notice requirements lead to a substantial reduction in equilibrium wages, which sustains the employment level.

When advance notice requirements generate shirking behavior, their effects can be considerably larger. However, when the general equilibrium effects are taken into account, advance notice requirements actually have a positive effect on employment. This effect is of the same sign as in Addison and Grosso (1995), but the magnitude is much smaller.

In terms of welfare effects, I find that advance notice requirements are quite costly—in fact even costlier than firing taxes. While firing taxes equal to three months of wages reduce welfare by 0.56 percent, advance notice requirements lead to welfare costs that range between 0.86 percent and 3.08 percent, depending on the amount of shirking behavior generated.

However, the large welfare cost of advance notice requirements allowing for shirking behavior was calculated under the assumption that workers who shirk do not obtain leisure. This is probably an unrealistic assumption and, as such, we should interpret these results with caution. While the results in this article suggest that advance notice requirements can be extremely costly, in order to provide a more definite answer they should be analyzed in a model that explicitly considers the shirking decisions. A model based on efficiency wages may provide a suitable framework of analysis.

APPENDIX: PARAMETERS

Prices and technology

$i = 0.01$ $\omega = 0.3297$ $\gamma = 0.64$

Productivity shocks

$s_0 = 0.00$ $s_1 = 1.00$ $s_2 = 1.32$ $s_3 = 1.79$ $s_4 = 2.35$
$s_5 = 3.19$ $s_6 = 4.19$ $s_7 = 5.38$ $s_8 = 7.30$ $s_9 = 10.65$

Distribution over initial productivity shocks

$\psi_0 = 9.995e{-1}$ $\psi_1 = 2.3e{-4}$ $\psi_2 = 6.8e{-5}$ $\psi_3 = 1.6e{-4}$ $\psi_4 = 0.0$
$\psi_5 = 0.0$ $\psi_6 = 0.0$ $\psi_7 = 0.0$ $\psi_8 = 0.0$ $\psi_9 = 0.0$

Transition matrix *Q*:

1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.087	0.848	0.065	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.005	0.084	0.879	0.032	0.000	0.000	0.000	0.000	0.000	0.000
0.005	0.000	0.086	0.847	0.062	0.000	0.000	0.000	0.000	0.000
0.005	0.000	0.000	0.088	0.877	0.031	0.000	0.000	0.000	0.000
0.005	0.000	0.000	0.000	0.090	0.846	0.059	0.000	0.000	0.000
0.005	0.000	0.000	0.000	0.000	0.092	0.808	0.095	0.000	0.000
0.005	0.000	0.000	0.000	0.000	0.000	0.094	0.873	0.028	0.000
0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.096	0.896	0.004
0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.099	0.896

NOTES

[1]For an extensive discussion of dismissal regulations, see Emerson (1988) and Piore (1986).

[2]If the establishment could rehire workers that were given advance notice, then it would give advance notice to all of its workers and rehire them at will the following period, depending on the value of the establishment's individual productivity. Clearly, if this were allowed, advance notice requirements would have no effect.

[3]Observe that variations in the productivity of the establishment determine its employment expansion and contraction over time.

[4]A main difference with Veracierto (2001) is that that paper had a flexible form of capital as an alternative factor of production, while in this article labor is the only factor. Another difference is that in the former paper entry of establishments was endogenous, while here it is exogenous.

[5]A Pareto optimal allocation maximizes the utility level of the representative agent within the set of feasible allocations.

[6]A good part of the welfare cost of advance notice requirements when shirking behavior is allowed for is due to the assumption that workers that shirk do not enjoy leisure.

[7]In particular, it corresponds to the economy without capital referred to in that paper as the "H-R economy."

REFERENCES

Addison J., and J. Grosso, 1995, "Job security provisions and employment: Revised estimates," Centre for Labour Market and Social Research, working paper, No. 95-15.

Bentolila, S., and G. Bertola, 1990, "Firing costs and labor demand: How bad is eurosclerosis?," *Review of Economic Studies*, Vol. 57, No. 3, pp. 381–402.

Davis, S., and J. Haltiwanger, 1990, "Gross job creation and destruction: Microeconomic evidence and macroeconomic implications," in *NBER Macroeconomics Annual*, *Vol. 5,* O. Blanchard and S. Fischer (eds.), pp. 123–168.

Dunne, T., M. Roberts, and L. Samuelson, 1989, "The growth and failure of U.S. manufacturing plants," *Quarterly Journal of Economics*, Vol. 104, No. 4, pp. 671–698.

Emerson, M., 1988, "Regulation or deregulation of the labour market," *European Economic Review*, Vol. 32, No. 4, pp. 775–817.

Hopenhayn, H., and R. Rogerson, 1993, "Job turnover and policy evaluation: A general equilibrium analysis," *Journal of Political Economy*, Vol. 101, No. 5, pp. 915–938.

Lazear, E., 1990, "Job security provisions and employment," *Quarterly Journal of Economics*, Vol. 105, No. 3, pp. 699–726.

Mehra, R., and E. Prescott, 1985, "The equity premium: A puzzle," *Journal of Monetary Economics*, Vol. 15, No. 2, pp. 145–161.

Piore, M., 1986, "Perspectives on labor market flexibility," *Industrial Relations*, Vol. 25, No. 2, pp. 146–166.

Veracierto, M., 2001, "Employment flows, capital mobility, and policy analysis," *International Economic Review*, Vol. 42, No. 3, pp. 571–595.